EVM User's Guide: BQ24810EVM

BQ24810 评估模块

说明

BQ24810 评估模块 (EVM) 是 BQ24810 IC 的评估系统。BQ24810 IC 是一款仅降压型电池充电控制器，具备混合动力升压模式、仅电池升压和处理器热量监控功能。输入电压范围为 4.5V 至 24V，具有 1-4 芯电池充电电压和 128mA 至 8.128A 充电电流的可编程输出。

开始使用

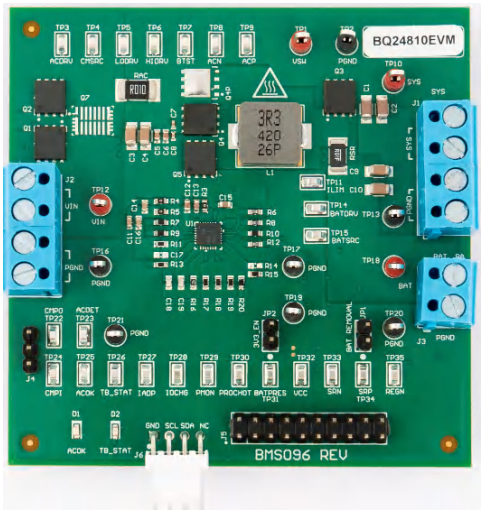
1. 在 ti.com 上订购 EVM
2. 订购 EV2400 以使用 bqStudio 与 EVM 通信，
3. 下载 BQ24810 BQZ 文件
4. 在 ti.com 上下载 BQ24810 EVM 设计文件

特性

- 混合动力升压模式，可使用适配器和电池一起为系统供电
  - 100µs 进入混合动力升压模式的超快速瞬态响应
- 仅电池升压模式，可支持更大的系统瞬态电压并延长电池运行时间
- 峰值功率两级输入电流限制，能够尽可能提高适配器的功率并尽可能减少电池放电
- 支持通过 4.5V 至 24V 适配器为 1 至 4 芯电池组充电
- 用于 CPU 节流的高精确度功率和电流监测
  - 全面的 PROCHOT 配置
  - ±2% 电流监测器精度
  - ±5% 系统电源监测器精度 (PMON)
- 自动选择适配器或电池作为 NMOS/双向 GAN 电源
  - 从电池移除状态退出学习模式时，ACFET 在 100µs 内快速导通
- 可编程的输入电流、充电电压、充电和放电电流限制
  - ±0.4% 充电电压（16mV/阶跃）
  - ±2% 输入电流（64mA/阶跃）
  - ±2% 充电电流（64mA/阶跃）
  - ±2% 放电电流（512mA/阶跃）
- 开关频率：300kHz、400kHz、600kHz 和 800kHz

应用

- 笔记本电脑、超极本、可拆卸电脑和平板电脑
- 工业和医疗设备
- 具有备用电池的系统
- 便携式设备



1 评估模块概述

1.1 简介

BQ24810 评估模块 (EVM) 是一款 SMBus 1 至 4 芯混合动力升压模式电池充电控制器（支持仅电池升压和处理器热量监控）。输入电压范围为 4.5V 至 24V，具有 1-4 芯电池充电电压和 128mA 至 8.128A 充电电流的可编程输出。典型应用包括笔记本电脑、平板电脑、医疗设备和便携式设备

该 EVM 不包含 EV2400 接口器件，也不为数字接口提供任何电气隔离。为了评估 BQ24810EVM，必须单独订购 EV2400；连接在 PC 和 EVM 板之间时，必须考虑电气安全注意事项。通过数字接口将 EVM 连接到 PC 时，建议使用具有隔离边界的数字隔离器。

1.2 套件内容

此 EVM 套件包括：

- 1 个 BQ24810EVM

1.3 规格

表 1-1. 建议运行条件

说明			最小值	典型值	最大值	单位
V_{IN}	电源电压	来自交流适配器输入的输入电压 (1)	18	19-20	24	V
V_{BAT}	电池电压	在 V_{BAT} 终端上施加的电压		0-17.6	19.2	V
I_{AC}	电源电流	来自交流适配器输入的最大输入电流			8	A
I_S	输出电流	输出电流（SYS 和 CHG）			8	A
T_J	工作结温范围		0		125	°C

(1) ACDET 偏置、R5 和 R6 针对此范围进行设置。对于较低的适配器电压，必须修改此分压器。使用适当的偏置后，$V_{IN\ MIN}$ 可以低至 4.5VDC。有关更多信息，请参阅数据表 (SLUSFR7)。

1.4 一般安全信息

为确保使用 BQ24810 EVM 或在其附近工作的任何人的安全，请注意以下警告和注意事项。请遵循所有安全防护措施。

警告

BQ24810EVM 电路模块在运行期间可能会因散热而变烫。切勿接触电路板。请遵守适用于相关实验室的所有适用安全规程。

小心
表面高温。接触会导致烫伤。请勿触摸！

警告

BQ24810EVM 的间隙和爬电距离小于高压电路板上通常使用的间隙和爬电距离，并且没有隔离边界。如果用户在该板上施加高电压，则所有端子均被视为具有高电压且危险带电。将该电路板连接到带电的导线时可能会发生电击。电路板需由专业人员小心处理。为安全起见，建议使用具有各种保护特性（例如过压和过流保护）的隔离式测试设备。

警告

此评估模块 (EVM) 上存在可能导致人身伤害的高电压。在使用此 EVM 时，请确认已遵循所有安全程序。切勿让已通电的 EVM 无人看管。

警告

断电后，板载电容器上可能存在高电压。在 EVM 断电后，请正确检查所有板载储能器并使其放电。

注意

在无人看管的情况下，请勿让 EVM 处于通电状态。

小心
EVM 上的通信接口未进行隔离。建议使用数字隔离器。确认在测试期间遵守所有高压安全预防措施。

小心
必须在端子块上实施用于实现额定电流的连接方式。没有为测试点设置板流额定值。

小心
电路模块可能会因过热而损坏。为避免损坏，请在评估期间监测温度并根据需要使系统环境冷却。操作时切勿使电流和电压超过限值

小心
施加外部电压可能会损坏测试设备。请检查您的设备要求并根据需要使用阻断二极管或其他隔离技术，以防止设备损坏。

小心
电路模块的板底上有信号迹线、元件和元件引线。这可能会导致电压、高温表面或尖锐的边缘暴露在外面。操作过程中请勿触摸电路板的底部。

小心
BQ24810 的默认设置可能不是专为用户的应用设计的。在器件上电之前，确认根据测试设置进行了正确的 EVM 设置。适当设置所有保护措施并限制电流，以确保安全运行。

小心
该电路板未安装保险丝，依靠外部电压源电流限制来验证电路保护。

1.5 硬件

1.5.1 IO 和跳线说明

表 1-2. 连接器/端口说明

插孔	说明
J1 - SYS	连接到系统
J1 - GND	电源地
J2 – DCIN	连接到交流适配器正输出
J2 – GND	连接到交流适配器负输出
J3 – BAT	连接到电池正极
J3 - GND	连接到电池负极
J4 - 1 CMPIN	独立比较器输入
J4 - 2 GND	模拟接地
J4-3 CMPOUT	独立比较器输出
J6 - 1 GND	通信接口
J6 - 2 SCL	
J6 - 3 SDA	
J6 - 4 NC	

表 1-3. 跳线说明

跳线	说明	出厂默认设置
JP1	使用 JP1 将 BQ24810 BATPRES 引脚连接到 BQ24810 REGN 引脚	已安装
JP2	使用 JP2 将 BQ24810 VIN/VSYS 连接到 TPS70933 VCC 引脚	已安装

2 软件

2.1 通信接口设置

充电器由使用 SMBus 寄存器的状态机控制，状态机基于 SMBus 寄存器做出决策。软件仅帮助读取和写入这些寄存器。

2.1.1 使用 EV2400 的 BQSTUDIO

下载 BQSTUDIOTEST 的最新版本。双击 *Battery Management Studio* 安装文件并执行安装步骤。该软件支持 Microsoft® Windows® XP、7 和 10 操作系统。启动 BQSTUDIO 并选择 *Charger*。如果“Charger”中未显示 BQSTUDIO 的 EVM 配置文件，请关闭 BQSTUDIO 并从 www.ti.com 的 EVM 产品文件夹下载 .BQZ 文件，或者通过 e2e.ti.com 申请该文件。该文件必须保存到 C:\XXX\BatteryManagementStudio\config 中，其中 XXX 是用户选择安装 BQSTUDIO 的目录。

3 BQ24810 EVM 评估

节 3.1 和 节 3.2 介绍了该设备及设备设置。

3.1 设备

- **电源：**
  - 电源 #1 (PS#1)：需要一个能够提供 20V、5A 的电源。
  - 电源 #2 (PS#2)：需要一个能够提供 20V、3A 的电源。
- **负载：**
  - LOAD #1：一个可在恒流模式下运行的 30V（或更高）、5A（或更高）电子负载。
  - LOAD #2：HP 6060B 3-60V/0-60A、300W 系统直流电子负载或等效设备。
- **仪表：**六个 Fluke 75 万用表（性能相当或更高）或：三个性能相当的电压表和三个性能相当的电流表。
- **计算机：**至少有一个 USB 端口和一条 USB 电缆的计算机。
- **EV2400 通信套件**
- **软件：**有关软件设置，请参阅“通信接口设置”。

3.2 设备设置

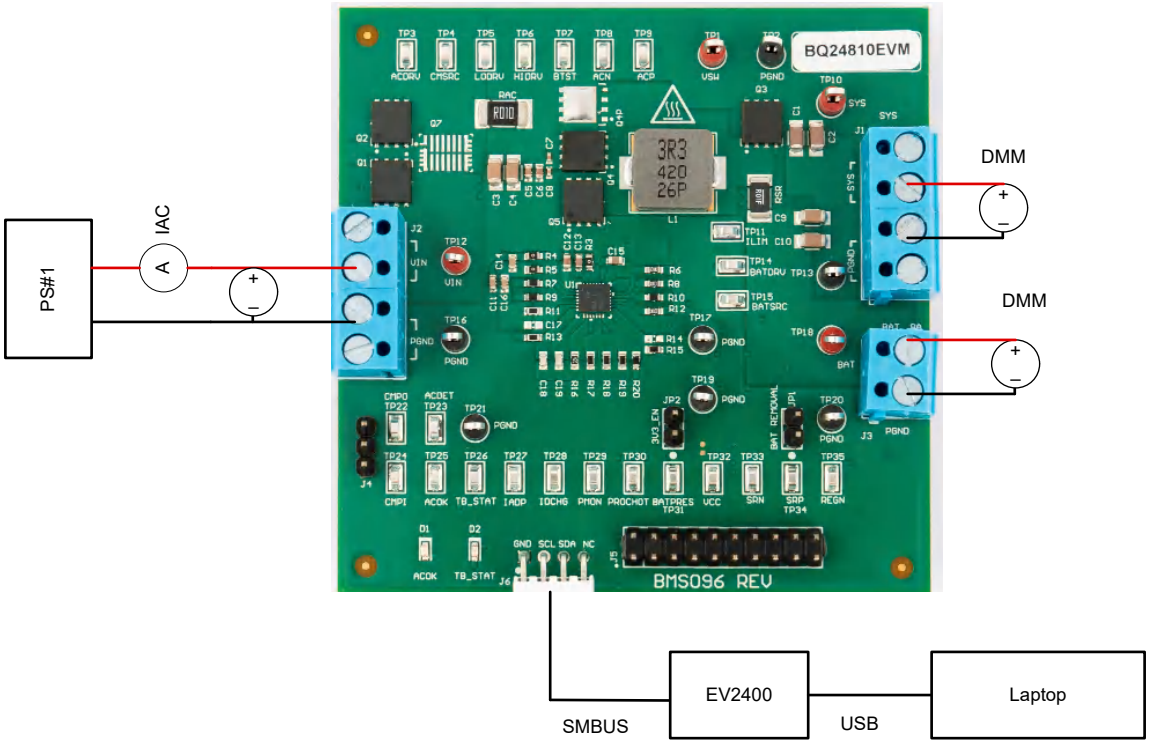
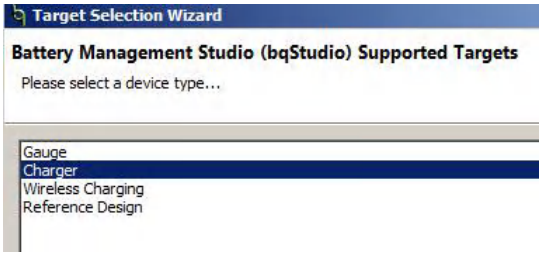


图 3-1. BQ24810 EVM 的设备设置

根据以下指南来设置设备：

1. 将电源 #1 (PS#1) 设置为 20V ±100mVDC，电流限制设置为 > 5A。关闭电源。
2. 将 PS#1 与一个电流表（万用表）串联，然后连接到 J2（VIN、GND）
3. 在 J2 两端（VIN、GND）连接一个电压表
4. 在 J3 两端（BAT、GND）连接一个电压表
5. 在 J1 两端（SYS、GND）连接一个电压表
6. 确保按照“IO 和跳线说明”中所述安装跳线。
7. 对于 SMBus 通信，请执行以下步骤：
   a. 将 J6 连接到 EV2400。将 J5 连接到 EV2400 上的 *SMB* 端口 1
   b. 开启计算机和 PS#1。打开 bqStudio 软件。
   c. 选择 *Charger* 并点击 *Next* 按钮。



d. 在 *Select a Target* 页面中选择 *Charger_1_00_BQ24810.bqz*。
e. 然后点击 *Registers* 按钮。
f. 选择目标器件后，点击 *Read Register* 按钮。
g. 将看门狗设置为禁用。

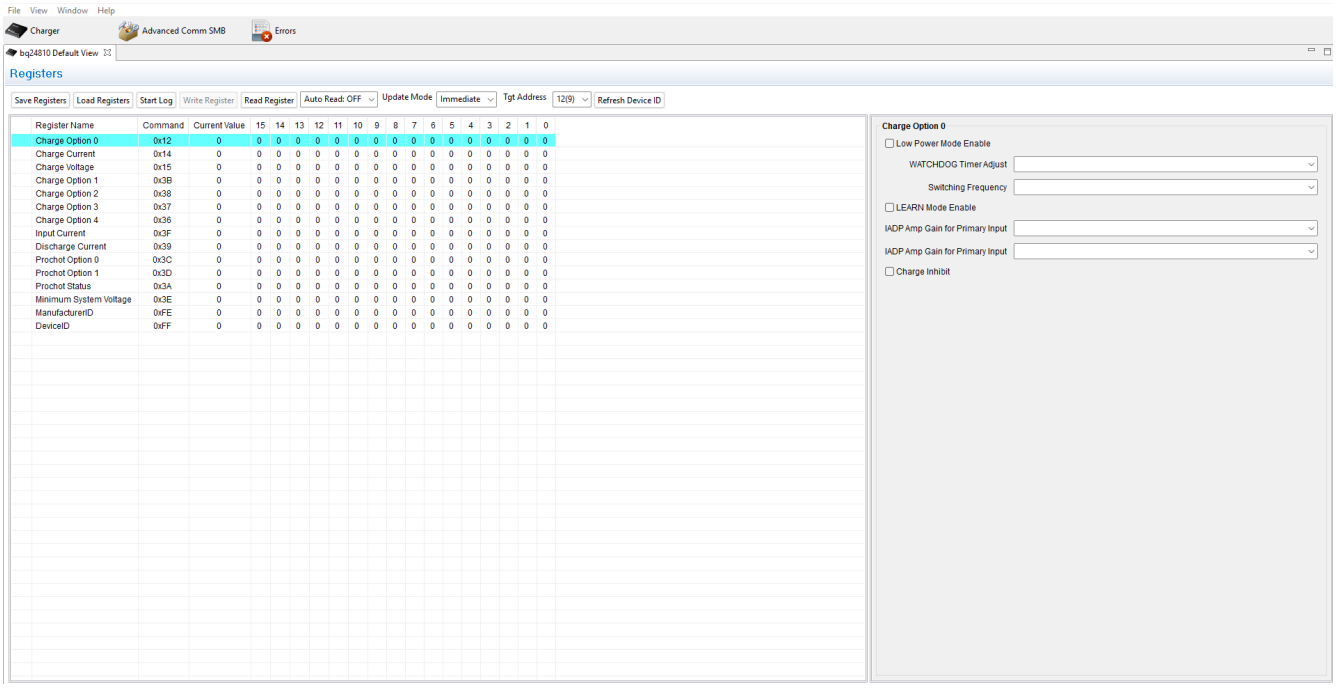


图 3-2. BQ24810Evaluation 软件的主窗口

3.3 BQ24810 EVM 测试程序

3.3.1 交流适配器检测阈值

执行以下步骤来设置交流适配器检测阈值：

1. 确保执行了设备设置步骤。
2. 开启 PS#1

   这一步未连接负载 #1 和负载 #2。
3. 将 PS#1 的输出电压增加至 20.0V
   a. 测量 → V[TP23(VCC)] = 19.6V ±0.5V
   b. 测量 → V[TP12(ACDET)] = 2.7V ±0.1V
   c. 测量 → V[TP13(ACOK)] = 3.3V ±0.1V
   d. 测量 → V[TP3(SYS)] = 20.0V ±0.5V
   e. 测量 → V[TP22(REGN)] = 6V ±0.6V
   f. 测量 → V[TP20(ILIM)] = 0.79V ±0.1V

3.3.2 充电器参数设置

在主软件窗口中，点击右上角的 *Refresh* 按钮。确保没有错误信息。

1. 在 *ChargeCurrent* 寄存器中键入“512”(mA)，然后点击 *OK*。这会设置电池充电电流调节阈值。
2. 在 *ChargeVoltage* 寄存器中键入“12592”(mV)，然后点击 *OK*。这会设置电池电压调节阈值。
3. 测量 → V(TP5(BAT)) = 12.6V ±200mV

3.3.3 充电电流和交流电流调节 (DPM)

1. 将负载 #2 与一个电流表（万用表）串联，然后连接到 J3（BAT、GND）。确保在 J2 两端（BAT、GND）连接一个电压表。开启负载 #2。使用恒压模式。将输出电压设置为 10.5V。
2. 将负载 #1 的输出与一个电流表（万用表）串联，然后连接到 J1（SYS、GND）。确保在 J1 两端（SYS、GND）连接一个电压表。开启负载 #1 的电源。
3. 在 *ChargeCurrent* 寄存器中键入“2944”(mA)，然后点击 *OK*。
   这会将电池充电电流调节阈值设置为 2.944A。
   - 测量 → IBAT = 3000mA ±300mA
   - 测量 → V[TP14(IIADP)] = 340mV ±40mV
4. 将负载 #1 电流设置为 3.0A ±50mA，但禁用输出。确保 ISYS = 0A ±10mA。启用负载 #1 的输出。
   - 测量 → ISYS = 3000mA ±300mA
   - 测量 → IBAT = 1800mA ±300mA
   - 测量 → IIN = 4100mA ±400mA
   - 测量 → V[TP14(IADP]) = 820mV ±100mV
5. 关闭负载 #1。
   - 测量 → ISYS = 0 ±100mA
   - IBAT = 3000mA ±300mA

3.3.4 混合升压模式

对于混合升压模式，请执行以下步骤：

1. 在 *ChargeOption3* 值中输入“1A44”，以启用混合升压功能
2. 将负载 #2 更改为 PS#2。确保在 J2 两端（BAT、GND）连接一个电压表。
3. 启用 PS#2 的输出。确保输出电压为 10V ±500mV 且电流限制为 3A。

4. 将负载 #1 负载电流设置为 5.0A ±50mA。进入升压模式。
   - 测量 → ISYS = 5000mA ±500mA
   - 测量 → IBAT = -2000mA ±600mA
   - 测量 → IIN = 4100mA ±400mA
   - 测量 → V[TP15(IIDCHG)] = 270mV ±100mV
5. 将负载 #1 负载电流设置为 0.5A ±50mA。退出升压模式。返回充电模式。
   - 测量 → ISYS = 500mA ±50mA
   - 测量 → IBAT = 3000mA ±300mA
   - 测量 → IIN = 2100mA ±400mA

3.3.5 仅电池升压模式

仅电池升压选项的设置如下：

1. 断开 PS#1 与 J2（VIN、GND）的连接
2. 在 *ChargeOption2* 值中输入“00C0”，以启用仅电池升压功能
3. 在 *ChargeOption0* 值中输入“0108”，以禁用低功耗模式并禁用看门狗计时器。
4. 在 *MinSysVoltage* 值中输入“2800”，将电池升压的进入阈值设置为 10.24V。
5. 将 PS#2 的电压降至 9.0V，以进入仅电池升压模式
   - 测量 → V[TP3(VBATT)] = 9.0V ±300mV
   - 测量 → V[TP2(VSYS)] = 12.0V ±600mV

3.3.6 电源路径选择

电源路径选择的设置如下：

1. 将负载 #2 更改为 PS#2。确保在 J3 两端（BAT、GND）连接一个电压表
2. 启用 PS#2 的输出。确保输出电压为 10V ±500mV，电流限制为 3A。
3. 将负载 #1 负载电流设置为 0.5A ±50mA
4. 在 *ChargeOption0* 中输入“E109”，这会禁用充电
5. 确保在 J2 两端（BAT、GND）连接一个电压表
   - 测量 → V(TP3(SYS)) = 19.5V ±1V（适配器连接到系统）
6. 关闭 PS#1
   - 测量 → V[TP5(BAT)] = 10V ±1V
   - 测量 → V[TP3(SYS)] = 10V ±1V（电池连接到系统）

4 硬件设计文件

4.1 原理图

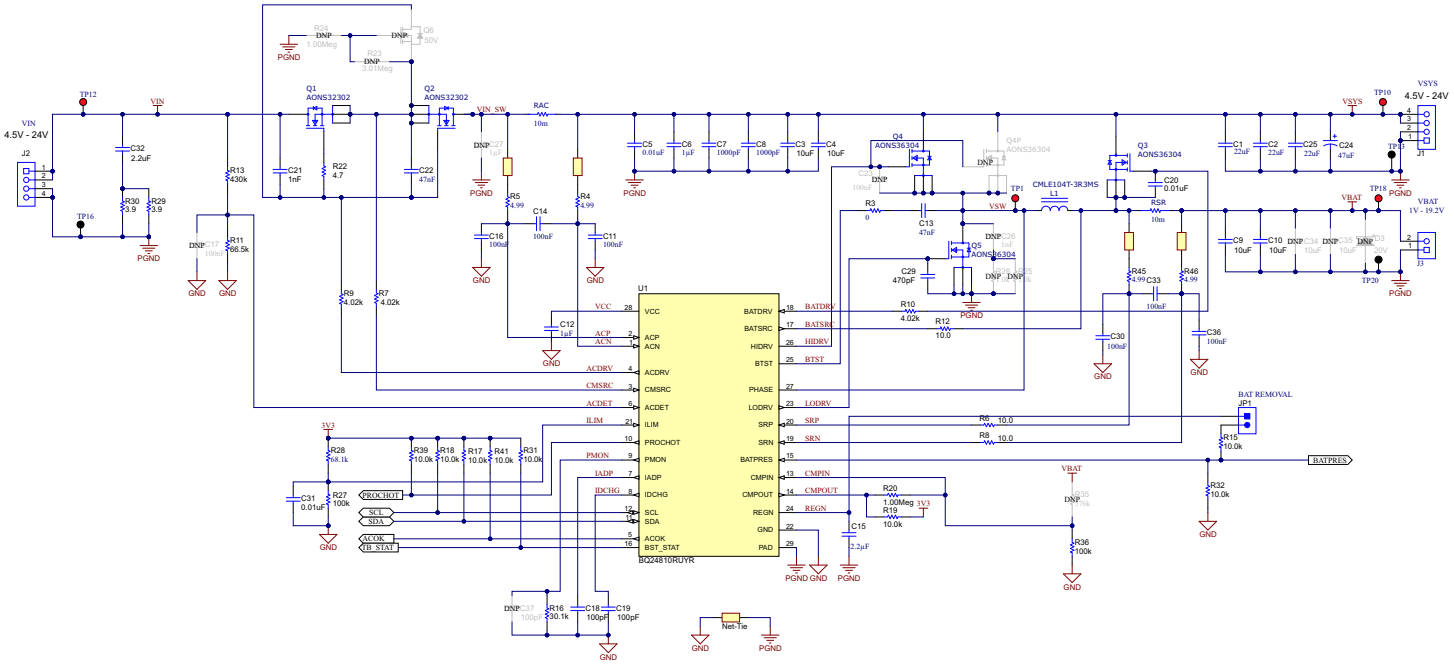
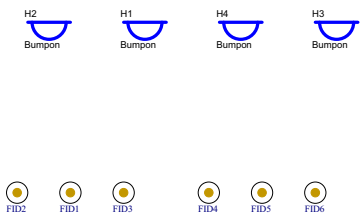


图 4-1. BQ24810EVM 原理图



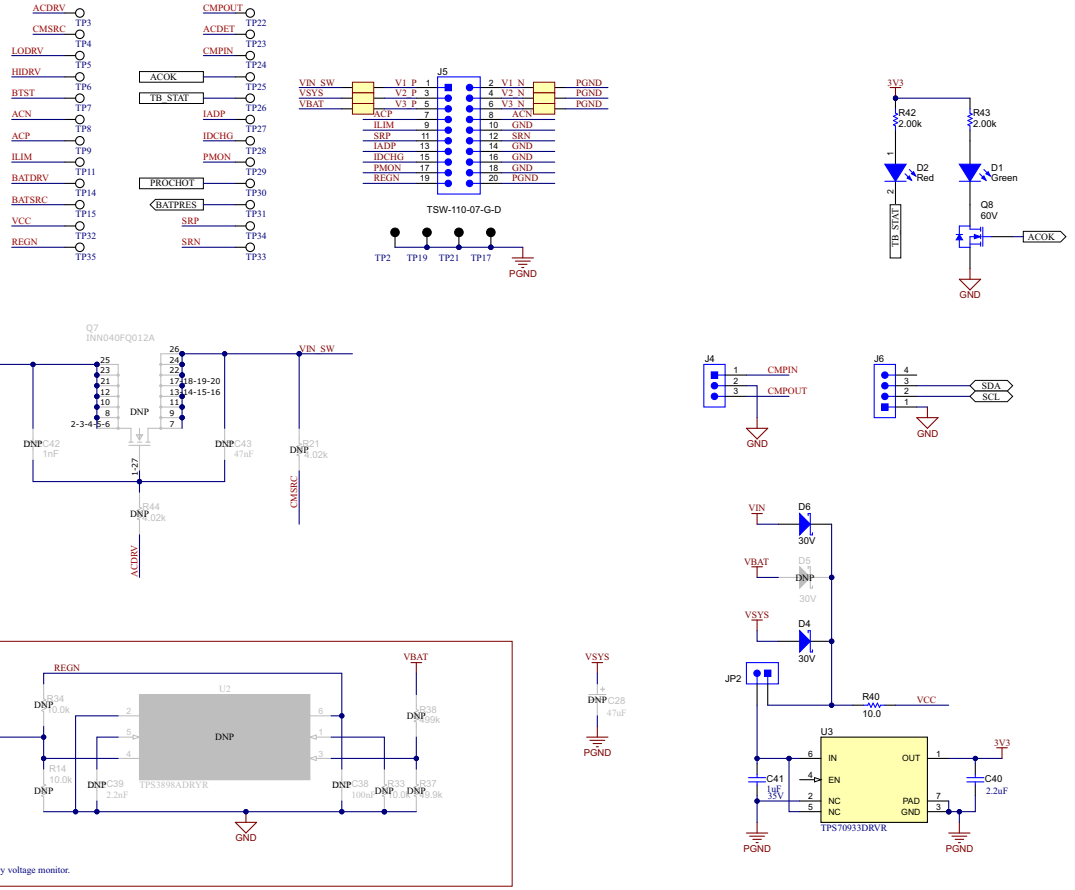
Variant/Label Table	
Variant	Label Text
001	BQ24810EVM
002	BQ24810EVM-GAN

ZZ1
Label Assembly Note
This Assembly Note is for PCB labels only

ZZ2
Assembly Note
These assemblies are ESD sensitive, ESD precautions shall be observed.

ZZ3
Assembly Note
These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.

ZZ4
Assembly Note
These assemblies must comply with workmanship standards IPC-A-610 Class 2, unless otherwise specified.



4.2 BQ24810EVM PCB 布局

图 4-2 至 图 4-7 展示了 BQ24810EVM 的 PCB 布局。

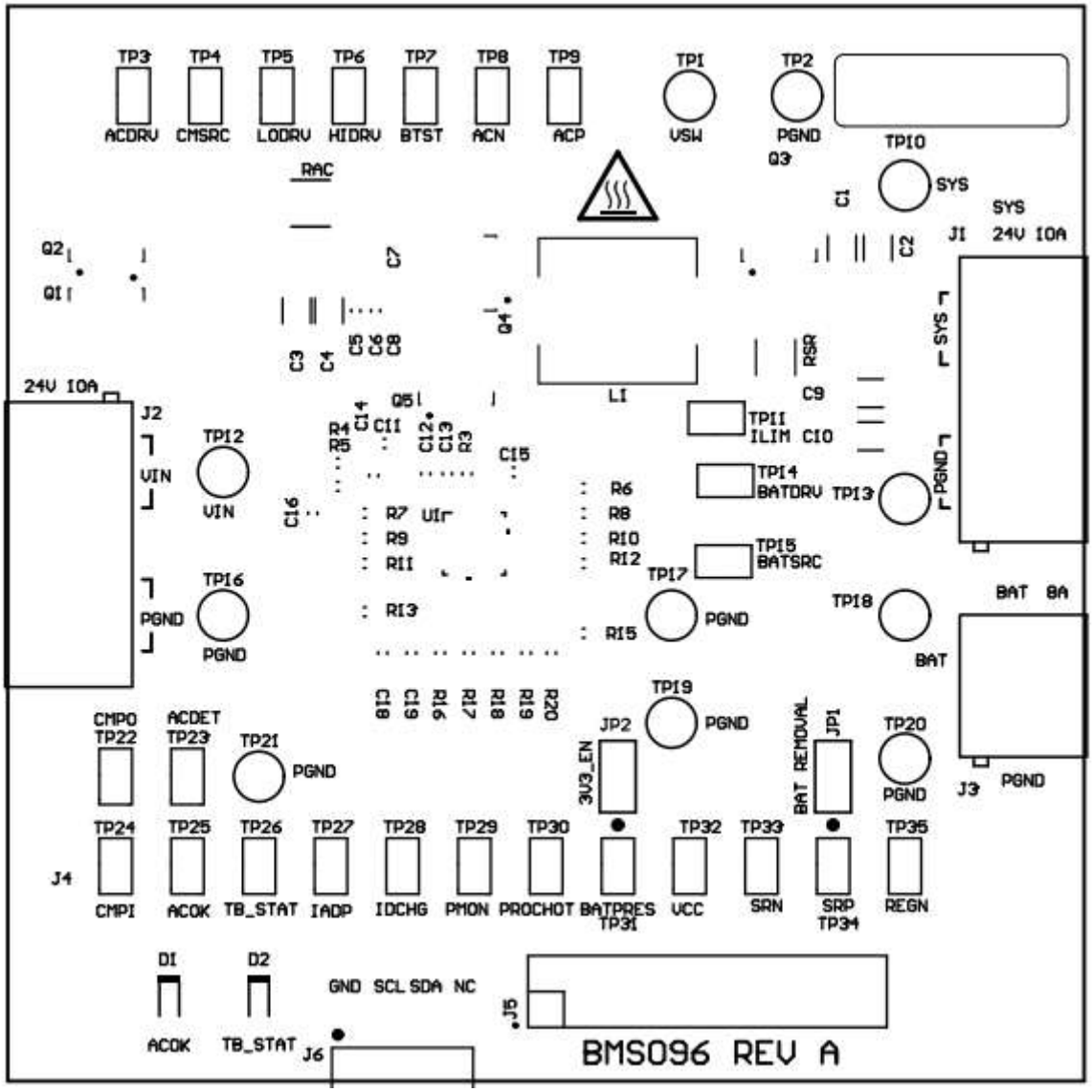


图 4-2. 顶层装配图

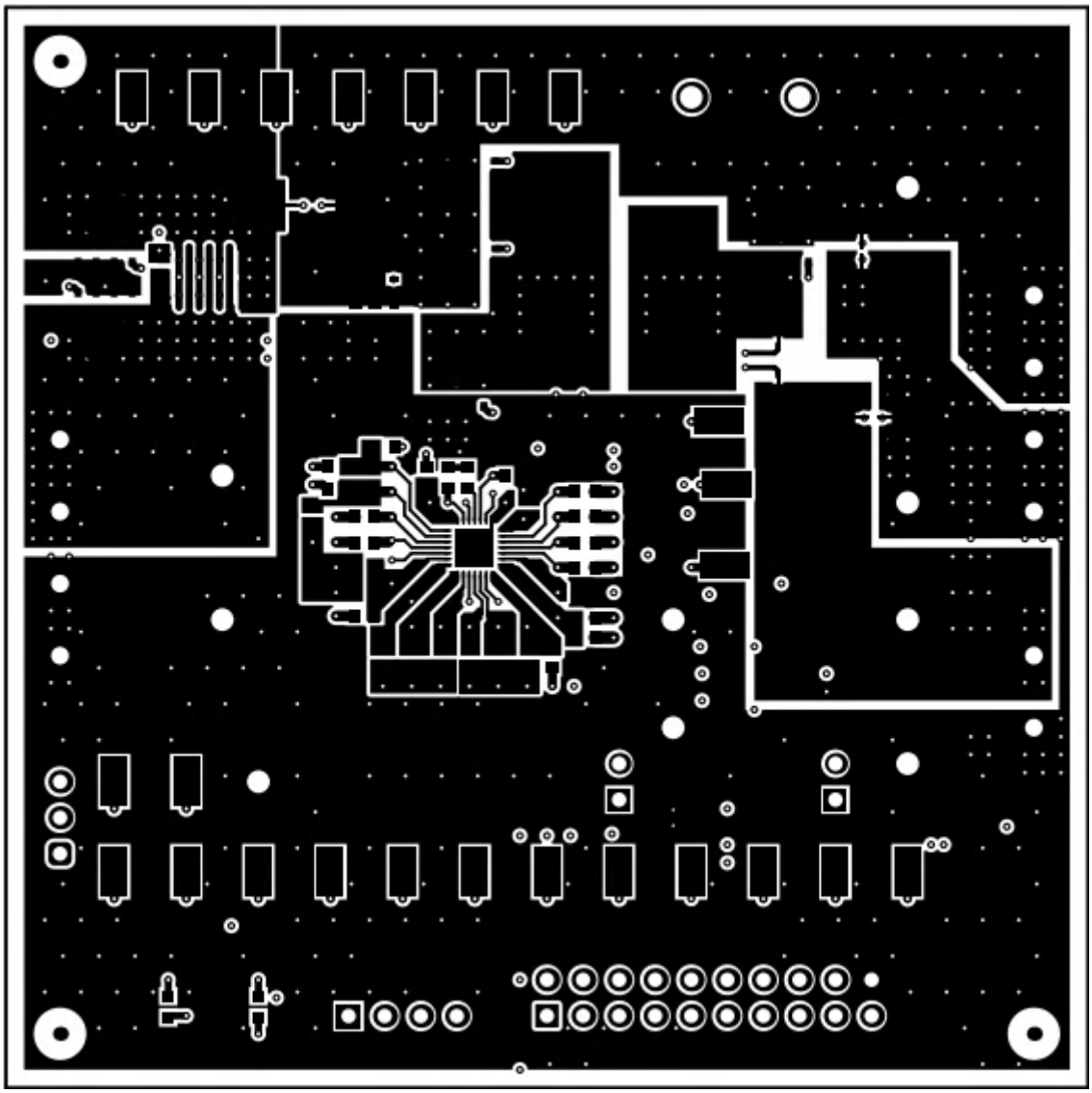


图 4-3. 顶层

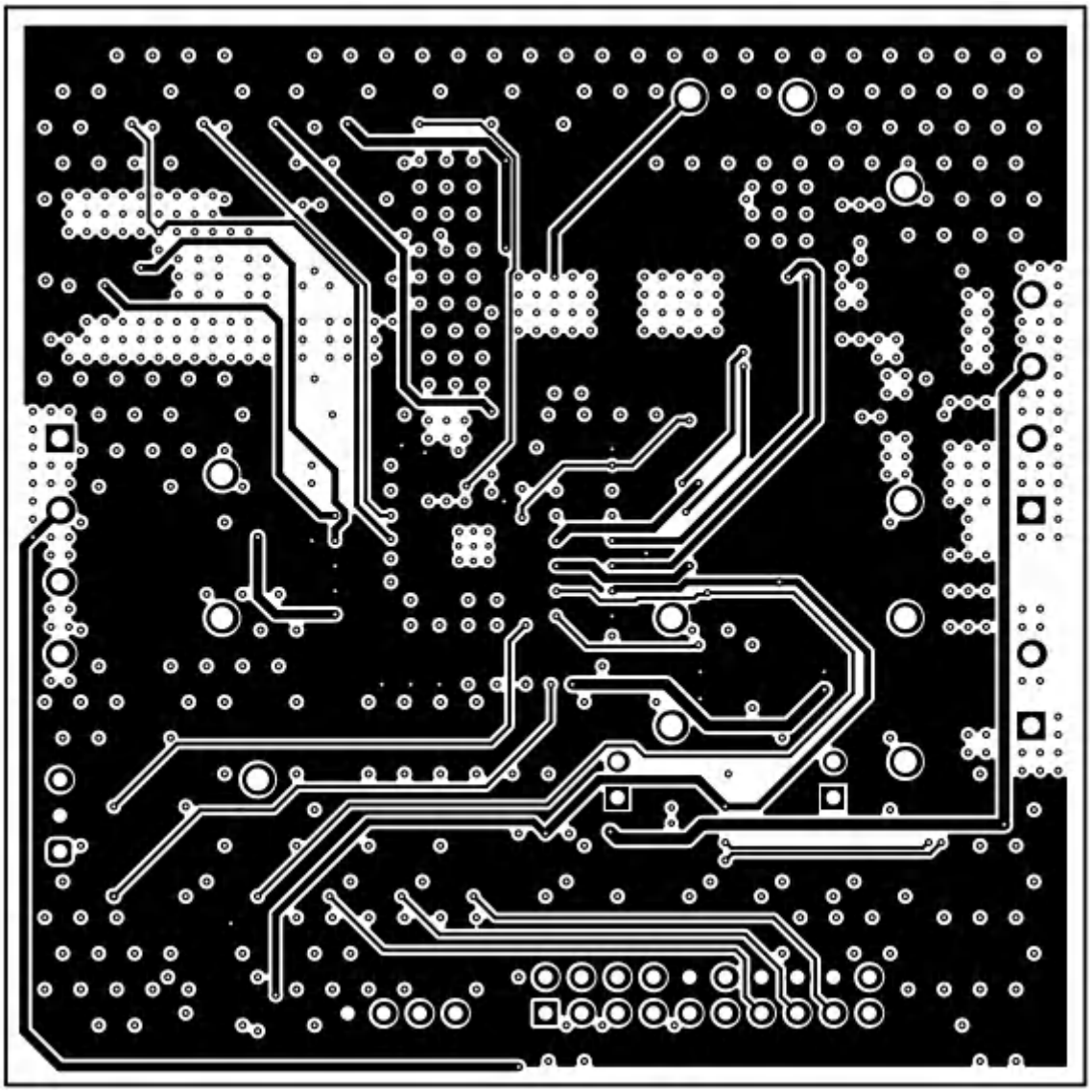


图 4-4. 中间层 1

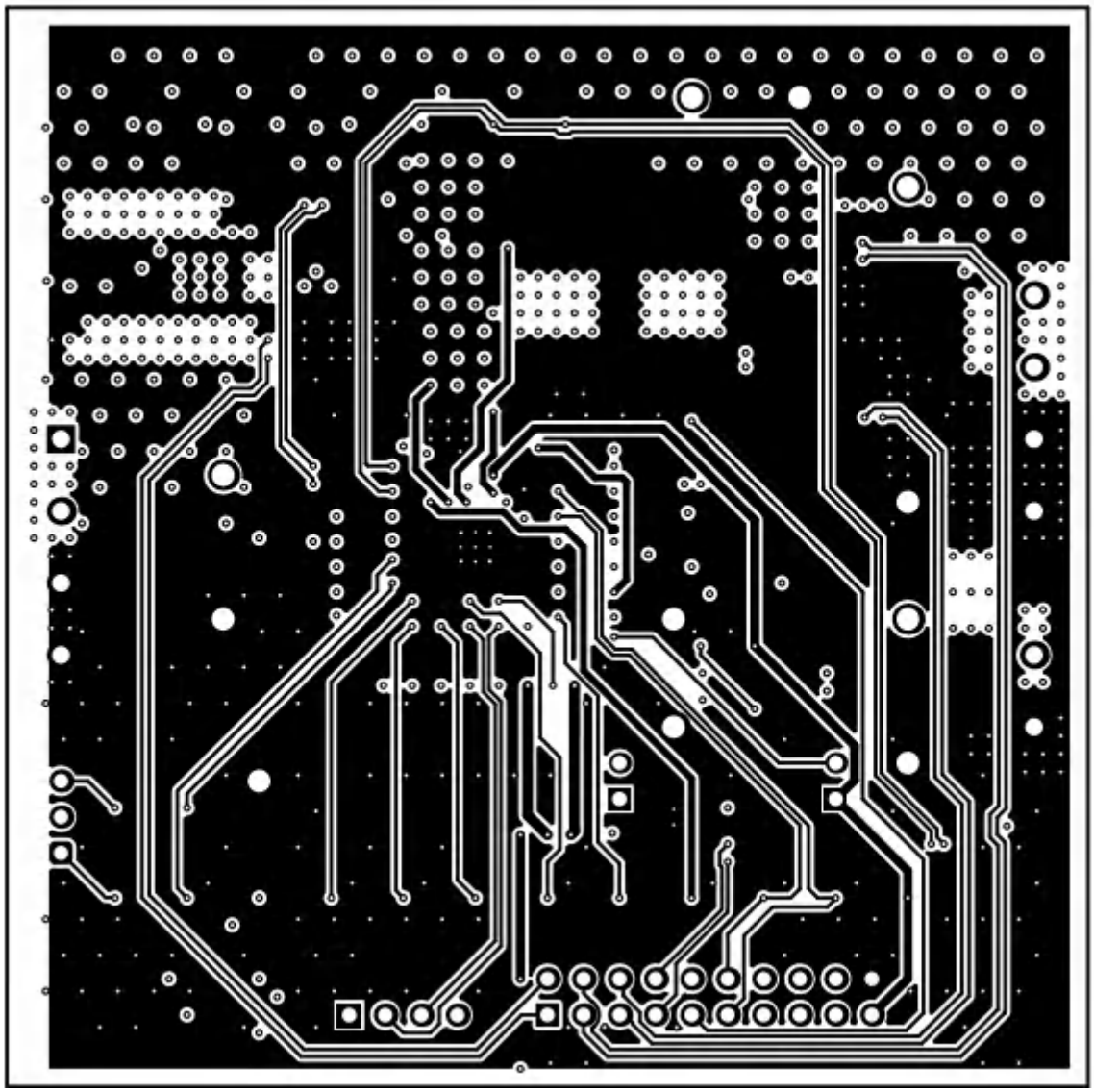


图 4-5. 中间层 2

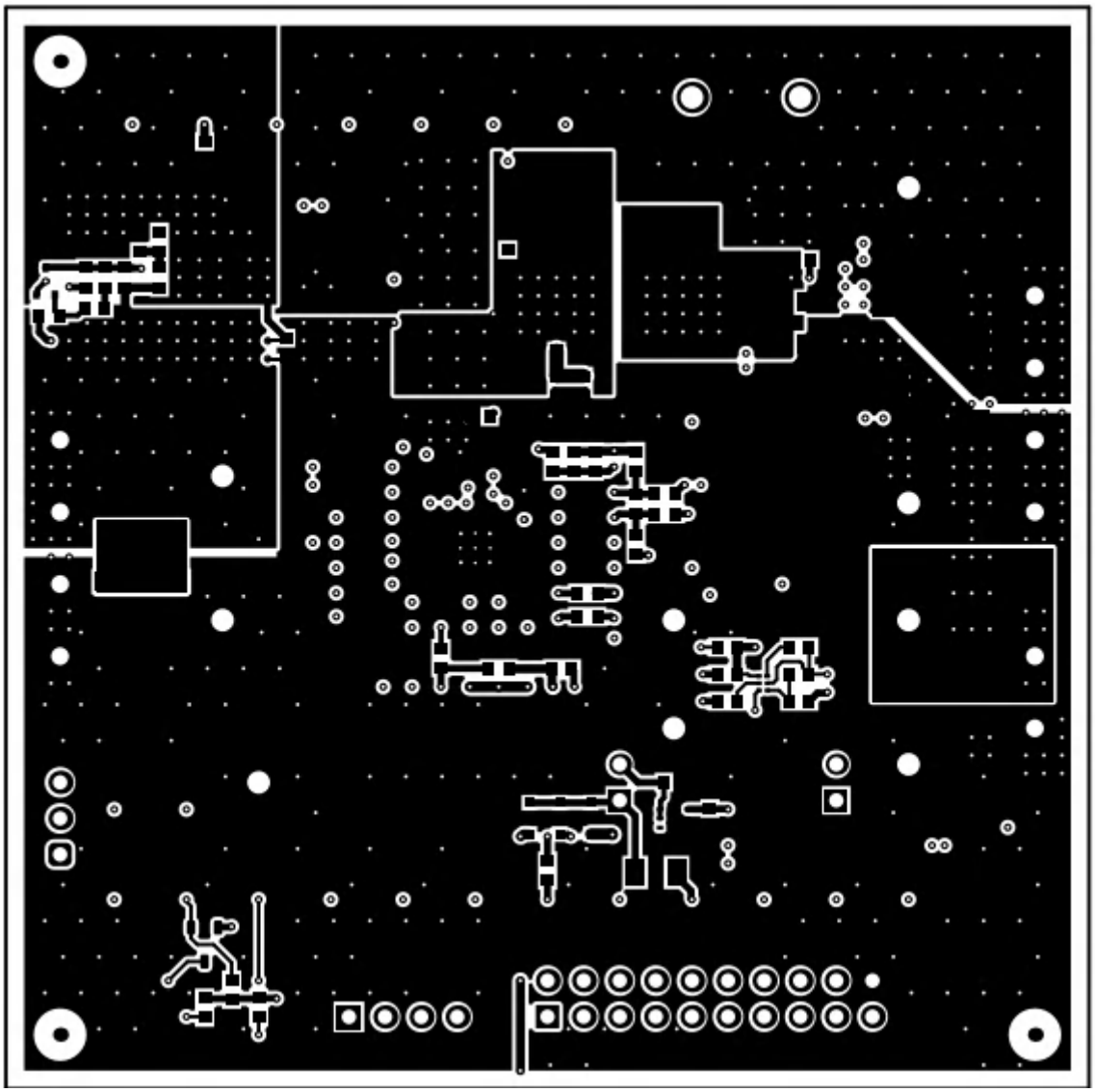


图 4-6. 底层

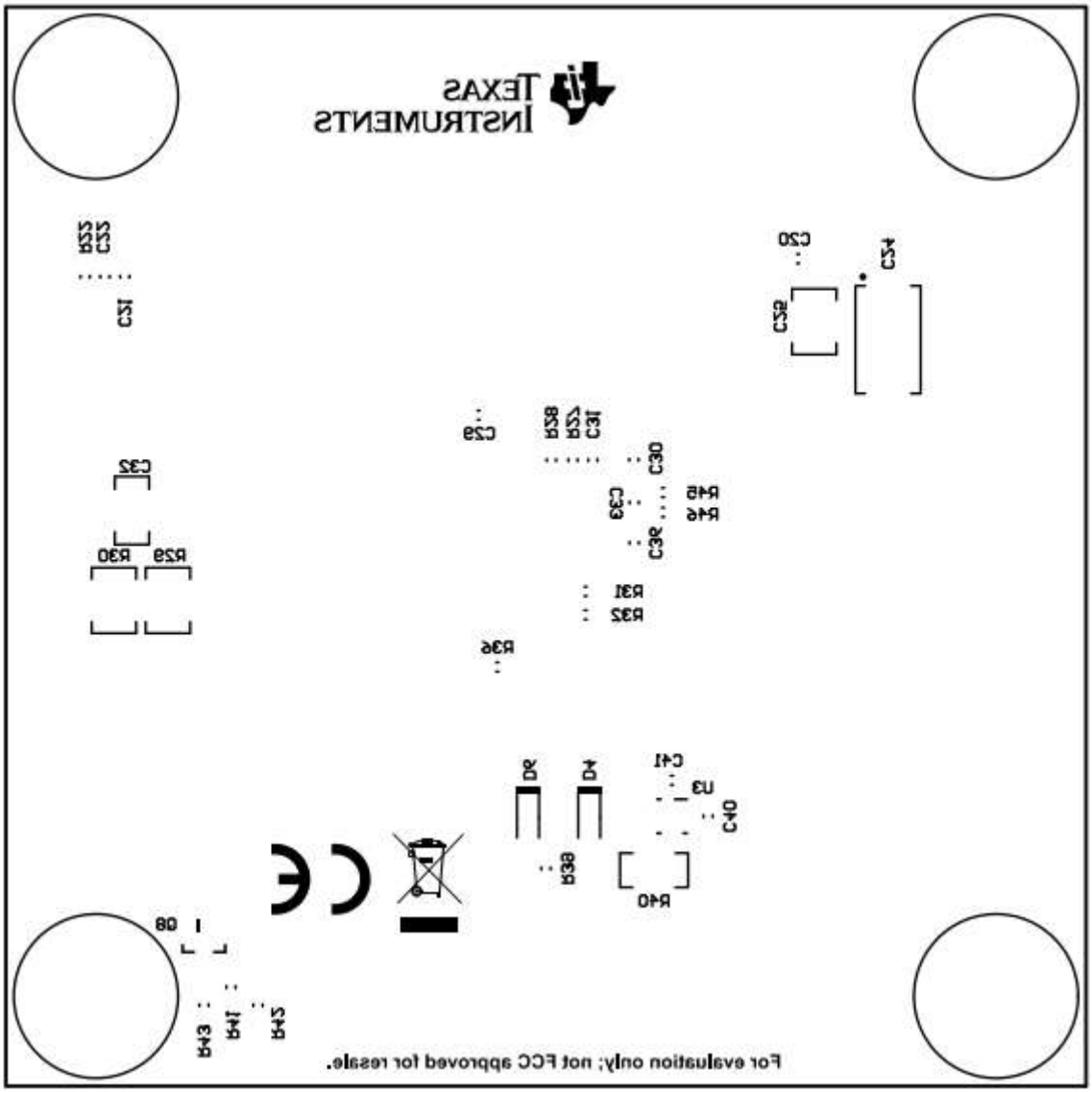


图 4-7. 底层装配图

4.3 物料清单

表 4-1. BQ24810EVM 物料清单

位号	数量	值	说明	封装参考	器件型号	制造商
!PCB1	1		印刷电路板		BMS096	不限
C1、C2	2	22uF	电容器，陶瓷，22µF，25V，+/-20%，X5R，1206_190	1206_190	C3216X5R1E226M160AB	TDK
C3、C4、C9、C10	4	10uF	电容，陶瓷，10uF，25V，+/-10%，X7R，1206_190	1206_190	TMK316B7106KL-TD	Taiyo Yuden
C5、C20、C31	3	0.01uF	电容，陶瓷，0.01uF，50V，+/-10%，X7R，0603	0603	C0603X103K5RACTU	Kemet
C6、C12、C41	3	1uF	电容，陶瓷，1uF，35V，+/-10%，X7R，AEC-Q200 0 级，0603	0603	GMK107AB7105KAHT	Taiyo Yuden
C7、C8	2	1000pF	电容，陶瓷，1000pF，50V，+/-10%，X7R，0402	0402	GRM155R71H102KA01D	MuRata
C11、C14、C16、C30、C33、C36	6	0.1uF	电容，陶瓷，0.1µF，25V，+/-10%，X7R，0603	0603	C0603C104K3RACTU	Kemet
C13、C22	2	0.047uF	电容，陶瓷，0.047uF，50V，+/-10%，X7R，AEC-Q200 1 级，0603	0603	CGA3E2X7R1H473K080AA	TDK
C15、C40	2	2.2uF	电容，陶瓷，2.2uF，16V，+/-10%，X7R，0603	0603	EMK107BB7225KA-T	Taiyo Yuden
C18、C19	2	100pF	电容，陶瓷，100pF，50V，+/-5%，C0G/NP0，0603	0603	GRM1885C1H101JA01D	MuRata
C21	1	1000pF	电容，陶瓷，1000pF，50V，+/-10%，X7R，0603	0603	CL10B102KB8NNNC	Samsung Electro-Mechanics
C24	1	47uF	电容，钽，47uF，25V，+/- 10%，0.125Ω，SMD	7343-31	TPSD476K025R0125	AVX
C25	1	22uF	电容，陶瓷，22uF，25V，+/-10%，X5R，1210	1210	CL32A226KAJNNNE	Samsung Electro-Mechanics
C29	1	470pF	电容，陶瓷，470pF，50V，+/-10%，X7R，0603	0603	C0603C471K5RACTU	Kemet
C32	1	2.2uF	电容，陶瓷，2.2uF，25V，+/-10%，X5R，1206	1206	12063D225KAT2A	AVX
D1	1	绿色	LED，绿色，SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On
D2	1	红色	LED，红色，SMD	红色 LED，1.6mm x 0.8mm x 0.8mm	LTST-C190KRKT	Lite-On
D4、D6	2	30V	二极管，肖特基，30V，0.2A，SOD-323	SOD-323	BAT54HT1G	ON Semiconductor
H1、H2、H3、H4	4		Bumpon，半球形，0.44 X 0.20，透明	透明 Bumpon	SJ-5303 (CLEAR)	3M
J1、J2	2		端子块，5.08mm，4x1，黄铜，TH	4x1 5.08mm 端子块	ED120/4DS	On-Shore Technology
J3	1		端子块，5.08mm，2x1，黄铜，TH	2x1 5.08mm 端子块	ED120/2DS	On-Shore Technology
J4	1		接头，100mil，3x1，金，TH	3x1 接头	TSW-103-07-G-S	Samtec
J5	1		接头，100mil，10x2，金，TH	10x2 接头	TSW-110-07-G-D	Samtec
J6	1		接头（摩擦锁），100mil，4x1，R/A，TH	4x1 R/A 接头	0022053041	Molex
JP1、JP2	2		接头，100mil，2x1，金，TH	接头，2x1，100mil	5-146261-1	TE Connectivity
L1	1		固定电感器，3.3uH，20%，100kHz，13A，10mΩ	SMT_IND_10MM85_10MM0	CMLE104T-3R3MS	Cyntec
LBL1	1		热转印打印标签，0.650	PCB 标签，0.650 x 0.200 英寸	THT-14-423-10	Brady
Q1、Q2	2		MOSFET，N 沟道，30V，1.9mΩ，8 引脚 DFN，EP T/R	DFN5x6-8	AONS32302	Alpha & Omega Semiconductor
Q3、Q4、Q5	3		MOSFET，N 沟道，30V，3.5mΩ，8 引脚 DFN，EP T/R	DFN5x6-8	AONS36304	Alpha & Omega Semiconductor
Q8	1	60V	MOSFET，N 沟道，60V，0.26A，SOT-23	SOT-23	2N7002ET1G	ON Semiconductor
R3	1	0	电阻，0，5%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06030000Z0EA	Vishay-Dale
R4、R5、R45、R46	4	4.99	电阻，4.99，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06034R99FKEA	Vishay-Dale
R6、R8、R12	3	10.0	电阻，10.0，1%，0.1W，0603	0603	RC0603FR-0710RL	Yageo
R7、R9、R10	3	4.02k	电阻，4.02k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06034K02FKEA	Vishay-Dale
R11	1	66.5k	电阻，66.5k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW060366K5FKEA	Vishay-Dale
R13	1	430k	电阻，430k，1%，0.1W，0603	0603	RC0603FR-07430KL	Yageo
R15、R17、R18、R19、R31、R32、R39、R41	8	10.0k	电阻，10.0k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW060310K0FKEA	Vishay-Dale
R16	1	30.1k	电阻，30.1k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW060330K1FKEA	Vishay-Dale

表 4-1. BQ24810EVM 物料清单（续）

位号	数量	值	说明	封装参考	器件型号	制造商
R20	1	1.00Meg	电阻，1.00M，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06031M00FKEA	Vishay-Dale
R22	1	4.7	电阻，4.7，5%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06034R70JNEA	Vishay-Dale
R27、R36	2	100k	电阻，100k，5%，0.1W，AEC-Q200 0 级，0603	0603	CRCW0603100KJNEA	Vishay-Dale
R28	1	68.1k	电阻，68.1k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW060368K1FKEA	Vishay-Dale
R29、R30	2	3.9	电阻，3.9，5%，0.5W，1210	1210	ERJ-14YJ3R9U	Panasonic
R40	1	10.0	电阻，10.0，1%，0.25W，AEC-Q200 0 级，1206	1206	ERJ-8ENF10R0V	Panasonic
R42、R43	2	2.00k	电阻，2.00k，1%，0.1W，AEC-Q200 0 级，0603	0603	CRCW06032K00FKEA	Vishay-Dale
RAC	1		10mΩ ±0.5% 2W 片上电阻 2512（公制 6432），汽车 AEC-Q200，电流检测，防潮金属膜	2512	PCS2512DR0100ET	Ohmite
RSR	1	10m	10mΩ ±1% 2W 片上电阻 2010（公制 5025）抗硫化，汽车级 AEC-Q200，电流检测，可承受脉冲，防潮金属元件	2010	WSLP2010R0100FEA	Vishay
TP1、TP10、TP12、TP18	4		测试点，多用途，红色，TH	红色通用测试点	5010	Keystone Electronics
TP2、TP13、TP16、TP17、TP19、TP20、TP21	7		测试点，多用途，黑色，TH	黑色通用测试点	5011	Keystone Electronics
TP3、TP4、TP5、TP6、TP7、TP8、TP9、TP11、TP14、TP15、TP22、TP23、TP24、TP25、TP26、TP27、TP28、TP29、TP30、TP31、TP32、TP33、TP34、TP35	24		测试点，微型，SMT	Testpoint_Keystone_Miniature	5015	Keystone Electronics
U1	1		具有仅电池升压模式和功率监控功能的 1-4 芯混合动力升压模式电池充电控制器，RUY0028A (WQFN-28)	RUY0028A	BQ24810RUYR	德州仪器 (TI)
U3	1		具有反向电流保护功能的 150mA、30V、超低 IQ、宽输入范围低压降稳压器，DRV0006A (WSON-6)	DRV0006A	TPS70933DRVR	德州仪器 (TI)

5 其他信息

5.1 商标

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6 修订历史记录

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (August 2025) to Revision A (January 2026)	Page
• 更新了 EVM 主页链接	1
• 添加了*软件*部分，以包含 GUI 选择	4
• 添加了*通信接口设置* 部分，以包含 GUI 选择	4
• 已使用正确的物料清单更新 表 4-1	17

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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